RESEARCH DEPARTMENT

THE TELEFUNKEN MICROPHONES TYPE ELAM 200 AND ELAM 201

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SUMMARY.

Tests have been carried out on specimens of the Telefunken electrostatic microphones type ELAM 200 and ELAM 201. The ELAM 200 microphone is pressure-operated while the ELAM 201 can be switched to give either omnidirectional or cardioid characteristics; identical pre-amplifier arrangements are used for both types.

The usual measurements of frequency response, sensitivity, impedance and susceptibility to magnetic fields were made and studio tests carried out.

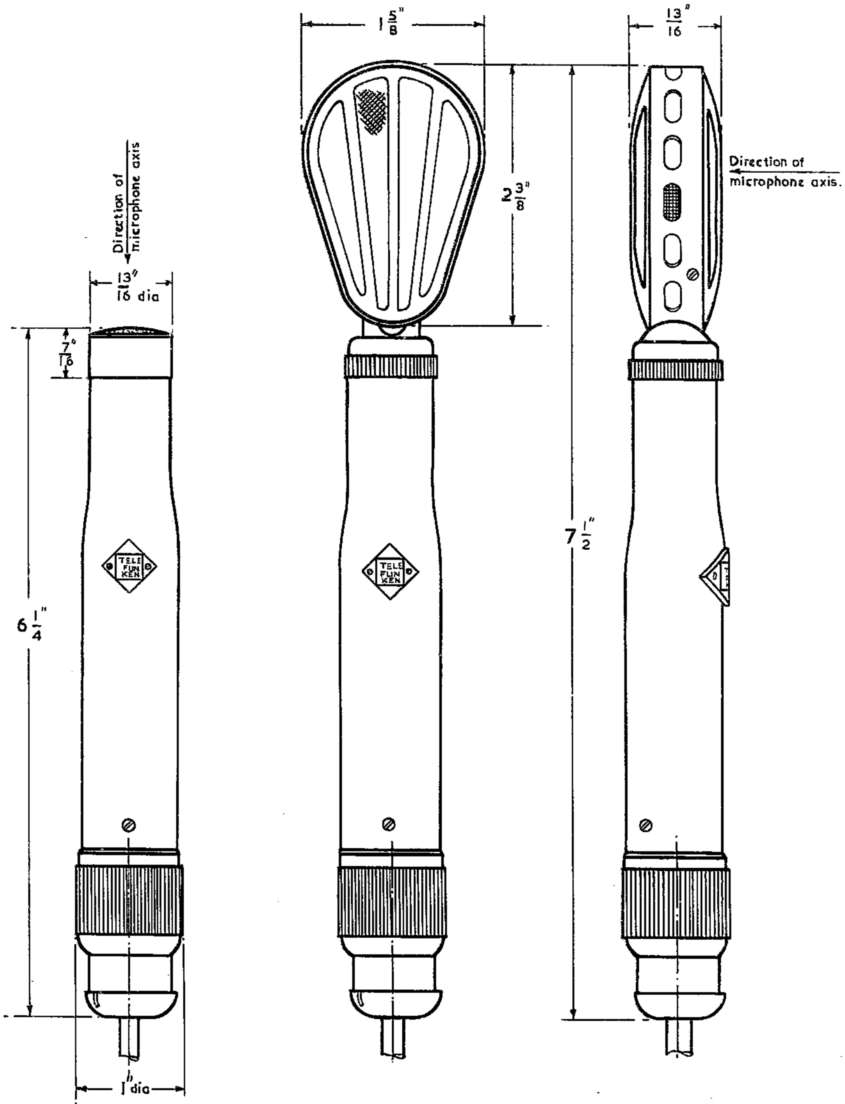
1. INTRODUCTION.

The electrostatic microphones ELAM 200 and ELAM 201, sometimes referred to as Schoeps microphones, are manufactured in Germany by Telefunken and marketed in this country by the Decca Record Co. Ltd. The capsule of the ELAM 200 is pressure-operated and nominally omnidirectional. The ELAM 201 contains two capsules, one operated by pressure and the other by pressure-gradient; provision is made for switching the pressure-gradient capsule in or out of circuit to give nominal cardioid or omnidirectional polar characteristics. Identical pre-amplifier and power supplies are used in the two types; the amplifier "head" is of unusually small size and the microphones were therefore considered to be of particular interest in view of their possible application in television.

The price of the ELAM 200 quoted in November 1953 was £102 and of the ELAM 201, £114.

2. DESCRIPTION OF MICROPHONES.

Fig. 1 shows the dimensions and external appearance of the ELAM 200 and ELAM 201 with pre-amplifier head. The capsule of the ELAM 200 has a slightly domed perforated protective cover. In the ELAM 201 the two capsules are housed in a case consisting of a metal frame backed by a fine wire mesh. It was not possible to carry out a detailed examination of these units without dismantling the case. The two-position switch already referred to is located at the base of the microphone head, which is pushed in or pulled out according to the polar characteristic required.



ELAM 200 ELAM 201

Fig. 1.

The pre-amplifier housing is of thin metal and it is doubtful whether it would stand up to service conditions. The high-potential connection from the capsule is made by a spring contact, which was likewise of flimsy construction, though it must in fairness be said that none of the faults referred to later were attributable to any weakness at this point. The circuit of the pre-amplifier is conventional, one side of the capsule being connected to frame. The polarising voltage is applied through a 70 megohm resistor which, together with the grid leak of 180 megohms gives an input impedance of approximately 50 megohms. The valve, a selected specimen of EF 94, is mounted, together with its grid circuit components, in the pre-amplifier head, while the output transformer and associated components are housed in a small cylindrical unit interposed half way along the 33 ft (10 m) long cable connecting the pre-amplifier to the supply unit. Power is derived from AC mains.

The weight of the capsule and pre-amplifier head is 0·2 lb (90 g) for the ELAM 200 and 0·24 lb (110 g) for the ELAM 201. The weight of the connecting cable with output transformer unit is 3 lb (1·3 Kg) and of the mains unit 6·5 lb (3 Kg).

3. FAULTS ON MICROPHONES.

Tests on both the ELAM 200 and ELAM 201 microphones were interrupted from time to time by technical faults in the pre-amplifier and capsule. The selected valves used gave trouble on several occasions, and an anode resistance failed during studio trials. The two-position switch on the ELAM 201 microphone head developed a fault and the microphone had to be repaired by the makers. Even after these troubles had been overcome, the sensitivity and frequency characteristics of the ELAM 201 were found to vary somewhat with time, so that the results of the measurements could not be given with the usual standard of accuracy.

4. METHOD OF MEASUREMENT.

All the acoustic tests on the microphones were carried out in the dead room, with the exception of the measurements on the ELAM 201 in the cardioid condition, for which the travelling-wave duct was used at frequencies below 200 c/s. Measurements were made by the method of substitution, using a calibrated pressure microphone as standard. The accuracy of comparison with the standard is within ± ½ dB and the accuracy of calibration of the standard itself is also within ± ½ dB. In the case of the ELAM 201, however, instability of the microphone led to an additional ambiguity, amounting to approximately ± 1 dB, in the sensitivity figure. In the cardioid condition, the variation of frequency response arising from the same cause was greatest at low frequencies, amounting to approximately ± 3 dB at 50 c/s in the axial characteristic. The response to sound coming from the rear was subject to even larger variations. In the omnidirectional condition, the frequency characteristics were stable, from which it would appear that the cause of the variation lay in the pressure-gradient capsule.

5. FREQUENCY CHARACTERISTICS.

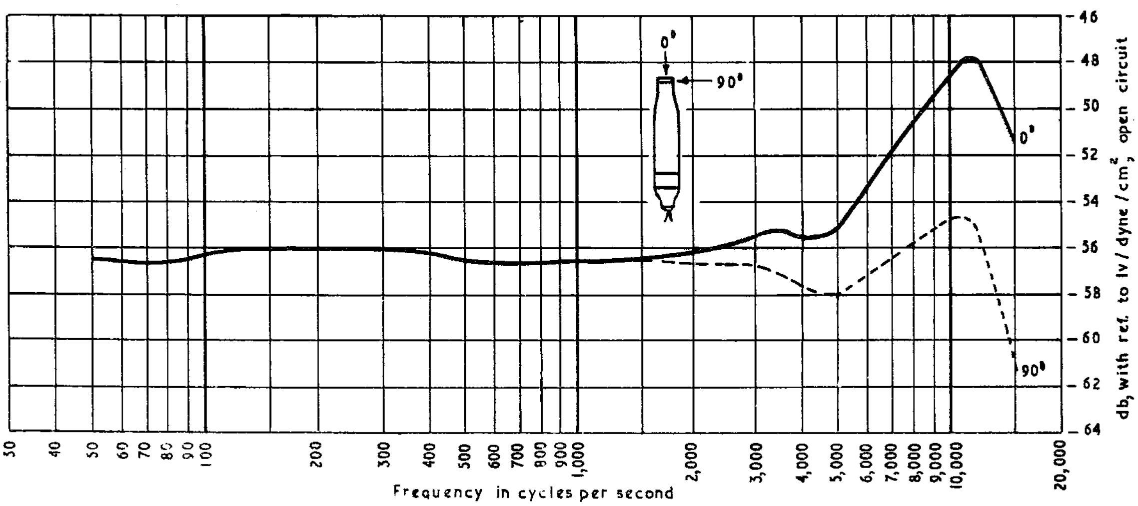


Fig. 2 - Microphone type ELAM 200. Frequency characteristics.

ELAM 200: Fig. 2 shows the open circuit frequency characteristics of the ELAM 200 for sound incident at 0° and 90°.

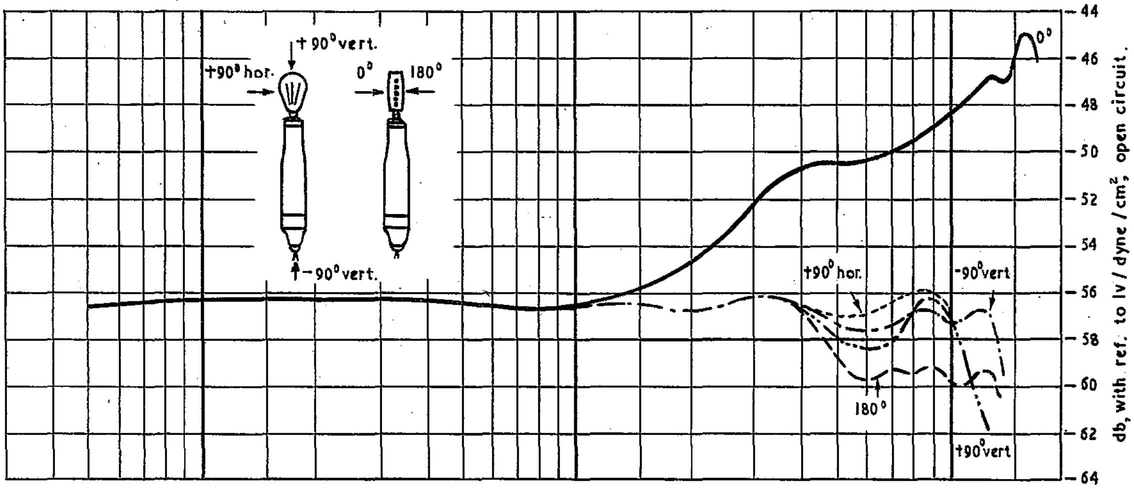


Fig. 3 - Microphone type ELAM 201. Frequency characteristics. Omnidirectional condition.

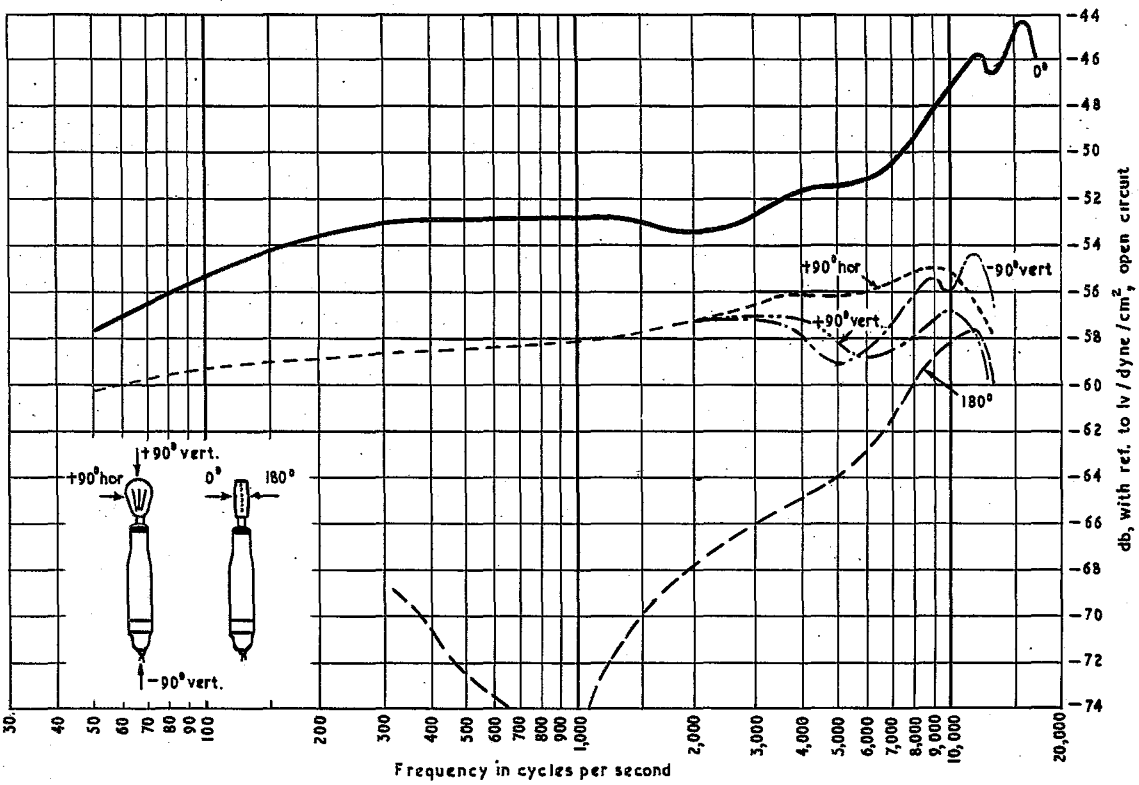


Fig. 4 - Microphone type ELAM 201. Frequency characteristics. Cardioid condition.

ELAM 201: Figs. 3 and 4 show the open circuit frequency characteristics of the ELAM 201 in the omnidirectional and cardioid conditions respectively. Because of the large drift in back response at low frequencies, the 180° curve is not continued below 300 c/s.

6. SENSITIVITY.

ELAM 200: The mid-band open-circuit sensitivity of the ELAM 200 is approximately −57 dB with reference to 1 volt/dyne/cm², the figure quoted by the manufacturers being −56 dB. If a 200 ohm/300 ohm transformer were used the open-circuit sensitivity at its secondary terminals would be approximately −55 dB.

ELAM 201: The mid-band open-circuit sensitivity of the ELAM 201 in the omnidirectional condition is approximately −57 dB with reference to 1 volt/dyne/cm². The sensitivity quoted by the manufacturers is −56 dB. A 200 ohm/300 ohm output transformer would raise the output sensitivity to −55 dB.

The open-circuit sensitivity of the ELAM 201 in the cardioid condition in the mid-band region is approximately −53 dB with reference to 1 volt/dyne/cm². The corresponding figure supplied by the manufacturers is −54 dB. The addition of a 200 ohm/300 ohm transformer would raise the open-circuit sensitivity to −51 dB.

7. IMPEDANCE.

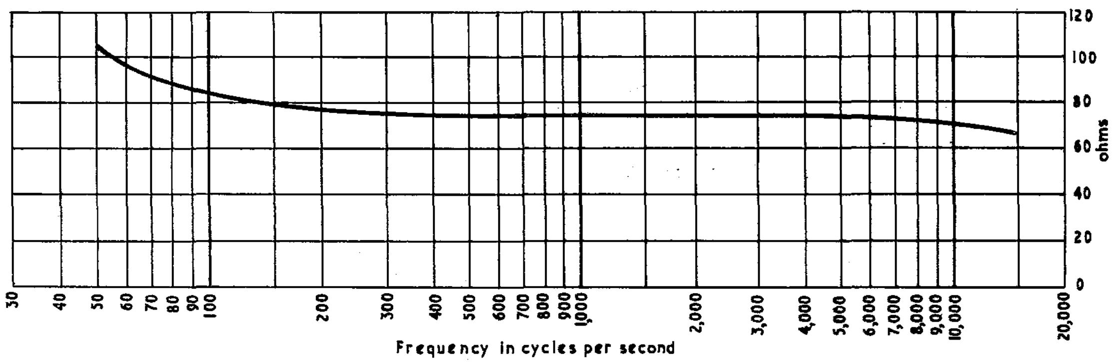


Fig 5 – Microphone type ELAM 200 or 201.
Modulus of output impedance.

Fig. 5 shows the variation of the microphone impedance with frequency. From the manufacturers' data it is evident that the microphones are intended to work into a load having an impedance of 200 ohms or more; in these circumstances the rise in internal impedance at low frequencies does not appreciably affect the frequency response.

8. NOISE.

8.1. General.

ELAM 200: The open-circuit noise level was −101 dB relative to 1 volt when weighted by an aural sensitivity network type ASN/3. The sound level at 1000 c/s required to give an output from the microphone equal to the weighted noise is approximately +30 dB with reference to 0·0002 dyne/cm².

ELAM 201: With the microphone in the cardioid condition, i.e. with both

capsules connected, the open-circuit weighted noise level was -96 dB relative to 1 volt; the sound level at 1000 c/s required to give an equal output is approximately +31 dB with reference to 0·0002 dyne/cm^2. Some of the noise appeared to originate in the microphone capsules themselves; in the absence of this effect, the output noise level would be the same as for ELAM 200, and the equivalent 1000 c/s sound level would be +26 dB.

8.2. Interference from Magnetic Fields.

The induction produced in the pre-amplifier head and transformer unit by external alternating magnetic fields was measured at 50 c/s, 1000 c/s and 10 000 c/s and found to be very small. The sound level at 1000 c/s required to give a signal equal to the voltage induced by a field of one milligauss was in all cases less than +10 dB with reference to 0·0002 dyne/cm^2.

9. STUDIO TESTS.

With the assistance of S.S.E.H.S.B.'s Staff, listening tests on the ELAM 200 and the ELAM 201 were carried out on orchestral rehearsals. The quality from the ELAM 200 was similar to that obtained with existing electrostatic pressure microphones of comparable dimensions. In the case of the ELAM 201, the salient feature was the bass loss in the cardioid condition; this loss appeared to be greater than that shown in Fig. 4, but the discrepancy may be accounted for by the drift in frequency characteristics referred to previously.

10. CONCLUSIONS.

Like most electrostatic microphones the sensitivities of the ELAM 200 and ELAM 201 are relatively high. However the self-generated noise in these microphones is also high and the signal-to-noise ratio is below average.

The frequency characteristics of the ELAM 200 are similar to those of other comparable types of microphone. The response of the ELAM 201 is maintained up to an unusually high frequency but there is a noticeable bass loss.

The pre-amplifier head is not very robust in construction and if the two specimens tested are representative, the standard of reliability of these microphones leaves something to be desired.

The ELAM 200 has a slight advantage in size over the omnidirectional electrostatic microphones already used in the B.B.C. The ELAM 201, while appreciably smaller than other available types having controllable directional properties, is not so small as some of the more recent designs having fixed cardioid characteristics.

In the circumstances, therefore, these microphones have little to recommend them for the Corporation's use.